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THE GREEN FLASH ON THE HORIZON.

By Arthur A. Rambaut, D.Sc., F.R.S.

Is the "green flash" at sunset a real objective change in the character of the light which reaches us from the sun just before its disappearance, or is it a subjective effect due to fatigue of the retina?

Several references to this interesting occurrence have lately appeared in the pages of *Symons's Meteorological Magazine*, and a good deal of doubt seems to be entertained in some quarters as to its objective character. It will, therefore, be well to examine what is known about it.

Of recent years this phenomenon has been frequently observed, and many descriptions of it will be found scattered through the pages of various scientific periodicals. The first account of the appearance, with which I am acquainted, is published in *Nature*, Vol. 29, p. 7. The Rev. G. H. Hopkins, of Week St. Mary Rectory, Cornwall, writes—"In a clear sky, as the disk of the sun sinks down below the horizontal line of the ocean, the parting ray is a brilliant emerald green. I have occasionally, but not often, had the pleasure of seeing this interesting phenomenon, as the clear atmosphere has to be accompanied with a cloudless region of the sky where the sun is setting. The same effect is not produced by the sun setting behind a distant bank of clouds. Probably the first ray from the rising sun would be the same unexpected colour."

On p. 76 of the same volume Mr. William Swan describes a similar appearance as seen by him at sunrise from the summit of the Rigi on September 13th, 1865. He writes—"The very first rays, although necessarily proceeding from the comparatively obscure limb of the sun, were dazzlingly brilliant and of a superb emerald green colour . . . . In *Nature*, Vol. xli. p. 495, will be found a notice of Prof. Sohncke's views with regard to the phenomenon, and on p. 538 of the same volume is a letter from Prof. Michie Smith dealing with the subject. Quite a number of references to the "green flash" will be found scattered through the pages of the *Journal of the British Astronomical Association*. The following list of the places where they occur (in which the volumes of the *Journal* are denoted by Roman, the pages by Arabic, numbers) may be found useful:—vii., 514; viii., 95 and 190; x., 364; xi., 75; xii., 32, 218, 248 and 289; xiii., 382; xv., 265, 366 and 382; and xvi., 23. The observa-

tion described by Mr. Whitmell at p. 289, vol. xii. (included in the above list) is particularly interesting and will engage our attention later. Notices will also be found in *Knowledge*, April, 1889, p. 126, and in the *Monthly Notices* of the *Royal Astronomical Society*, Vol. lxi. pp. 484 and 629, besides the references to the subject which have appeared in this Magazine for January and February of this year.

I had often looked for this phenomenon, but never until last autumn had I been so fortunate as to get a view of it. When starting, as a member of the British Association, on the expedition to South Africa in July last, this was one of the many unfamiliar objects which I looked forward to seeing; but although I was generally on the look out at the time of sunset, whether the sun went down behind a sea horizon, or sank into the apparently interminable veldt, it was not until the evening of September 27th, when the sun set behind the grand range of hills terminating in Cape Guardafui, that I saw the "green flash." It was then quite unmistakable, and those who are so fortunate as to see it, as I and several of my fellow-passengers on the *Durham Castle* did on that occasion, will not, I think, retain any lingering doubts as to the objective character of the phenomenon.

On that evening I was using a good pair of field-glasses by Ross, and watched the sun's disk as it sank lower and lower behind the outline of the hills. When the visible portion of the disk was reduced to a very narrow elongated segment I could distinctly see that the tips of the segment first became green, whilst the central portion still remained a brilliant yellow or orange. As the segment became more attenuated, the green patches spread rapidly from each end, until, meeting in the middle, they merged into each other and the whole narrow segment appeared of a vivid green or bluish tint. This lasted for a very short time, the length of which I made no attempt to estimate, and then entirely disappeared.

After that date the phenomenon became one of frequent, almost daily, occurrence as we passed northwards through the Red Sea, and was observed by many of the passengers on board the *Durham Castle*. It was seen both with and without glasses, but to enable one to follow the gradual extension and meeting of the green tips some little optical aid seems necessary. The majority of the passengers, many of them well known astronomers and meteorologists, were thoroughly convinced of the objective reality of the phenomenon. Of course, as might be expected in such a large number, there were found a few sceptics. These were, for the most part, inclined to look for a physiological explanation of the phenomenon, and to attribute it to fatigue of the retina. Looking over the literature of the subject it appears to me now that the number of observations recorded of the "green flash" at *sunrise* afford a complete refutation of the physiological theory, but at the time I was not so familiar with what had been written on the subject as I have since become, and in order to test the physiological hypothesis I observed the

sunrise on several mornings in succession, and I am very glad to be able to add my testimony to that of Major Courtenay and others who have watched the sun under similar circumstances. On the morning of September 29th I was rewarded by a magnificent exhibition of the "green flash" at sunrise which appears to me to dispose absolutely of the "fatigue" argument. On that occasion I was sitting beside Prof. H. A. Miers, Professor of Mineralogy at Oxford, near the stern of the vessel, and at my request he also watched for the first appearance of the sun above the horizon. I was using my glasses, and as the east brightened I concluded, from the brilliance of the sky above one particular part of the horizon, that the sun was just about to make its appearance at that spot, and kept the glasses directed upon it. I was, however, mistaken, and, while I was thus watching, Prof. Miers exclaimed, "There it is." I instantly swept the horizon till I found the sun, losing a fraction of a second in doing so, but nevertheless, when I found it, though the segment was then rapidly widening and had already become yellow about the middle, I could yet see the long vividly green points separating rapidly and shrinking in size until the greenness entirely disappeared. I am authorised by Prof. Miers to state that the first ray as seen by him with the naked eye was of a brilliant green colour, while another distinguished scientist who was standing by preferred to describe it as blue. On October 2nd I again saw the "green flash" at sunrise.

Remarking that the "green flash" is not usually found to occur when the sun is strikingly red before setting (a clear horizon with a minimum amount of atmospheric absorption, and consequently a yellow sun, appearing to be the most favourable conditions for the occurrence of the flash), and that violet, not green, is the colour complementary to yellow, we should expect the sun*set* flash, if it were due to fatigue, to be on the violet, rather than the green, side of blue, but it is difficult to see how the eye could possibly be fatigued in such a way as to bring about the appearance of a green flash at sun*rise*.

We must, therefore, look for the explanation in another direction.

The obvious explanation, and one that seems quite sufficient to account for all the observed facts, is that the "green flash" is due to the unequal refraction experienced by rays of different colours in passing through the Earth's atmosphere. It is a well-known fact that the setting sun has actually sunk completely beneath the horizon at the moment when it appears to us to be first in contact with it, and when the upper limb is just about to disappear it is actually 36′ below the horizon. We see it in virtue of the refraction which bends the rays round the horizon so as to reach our eyes. The red being the least refrangible is the first to be lost, and the different colours of the spectrum vanish one by one in the order—red, orange, yellow, green, blue, indigo and violet.

(To be continued.)

A RECORDING ANEMOMETER FOR KITES.

By W. H. Dines, F.R.S.

In the July number of this Magazine for 1904 (Vol. **39**, p. 109), a meteorograph designed for use with kites was described. Lately an arrangement for recording the velocity of the wind has been added to it.

This is effected by registering on the sheet the tension of a length of sewing cotton, to the end of which a small light sphere of about 3 inches diameter is secured. About 40 ft. of cotton are used, so that the ball may be far from the kite and out of the way of the disturbance it causes to the air motion. The pressure upon the ball in pounds is calculated by the formula, $P = \cdot 0015\ A.\ v^2$, where A is the cross section of the ball in square feet and v the velocity of the wind in miles per hour. Since the weight of the ball acts vertically and the wind pressure horizontally, the tension of the cotton is given by the expression $\sqrt{W^2 + P^2}$, where W is the weight of the ball. The values of this for 10, 20, 30, etc., miles per hour are calculated, and weights corresponding to each value cut from a piece of lead tube. The mode of registration is shown in fig. 1. An

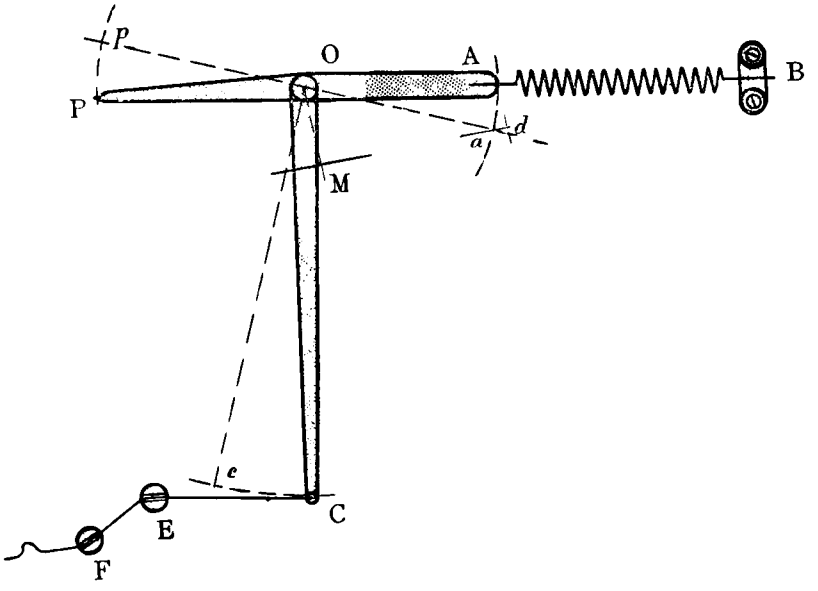

FIG. 1.—REGISTERING ARRANGEMENT OF KITE ANEMOMETER.

arm, A O P, with a pen at P, is pivoted at O, and another arm, O C, is rigidly attached to it. The cotton is tied to the point C and and passes through the two guides E and F, thence running freely through the bottom cell of the kite to the ball. A spiral spring of hard German silver wire is soldered to the arm at A and clamped in position at B. The cotton being pulled so that C comes to *c*, the

pen arm takes the position p O a, and the spring is extended through a length, d a. The force so produced is proportional to the extension, and it acts at the point M, so that the effective moment of the spring tending to draw back the pen is proportional to O M $\times$ a d; and for small deflections this is proportional to (P p)^3. There is also the force required to bend the spring into the position A d, apart from its extension, but this is of comparatively little consequence.

Toy celluloid balls weighing some 175 grains, a trifle under 3 inches diameter, are obtainable at most toy shops. With such a ball, the weights for 0, 10, 20, etc., miles per hour are about 175, 184, 268, 486, 820, 1260, 1810 grains. These balls give a reliable scale for values over 20 miles per hour. They are far stronger than is required and it should be possible to get much lighter ones specially made. With half the weight, the record would be reliable to 15 miles, which would suffice for work with kites.

The velocities are calculated for an air pressure of 30 inches of mercury, and an allowance must be made for decrease of density. This may be done approximately up to 10,000 feet by adding $1\frac{1}{2}$ per cent. to the velocity for each 1000 feet of vertical height.

The scale is obtained by hanging the weights previously mentioned to the end of the lever and marking the corresponding position of the pen. It has been found that the velocities thus recorded, or rather thus deciphered, have been in close agreement with the velocities obtained by cloud observations, whenever the latter have been available.

The upper wind is much steadier than that near the surface, and very little difficulty has been experienced from the oscillation of the pen. To check the oscillation the two guides, E and F, are placed so that F E C is not a straight line, and the departure from straight-

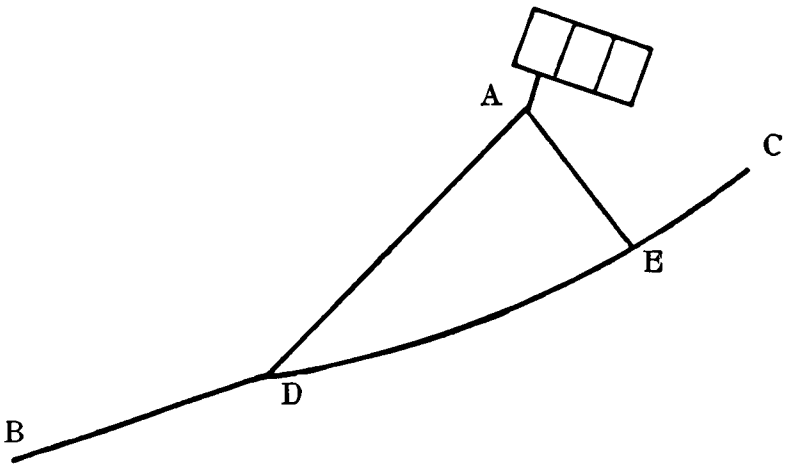

FIG. 2.—METHOD OF ATTACHING SUPPLEMENTARY KITE.

ness is easily arranged so that the friction of the cotton on the guides may check the oscillations, but yet allow every variation of the wind to be followed by the pen. Fresh cotton is used for each ascent, and no trouble has been found in starting the kite with the ball trailing out behind.

A plan of attaching a supplementary kite to the line, which avoids all risk of fouling, has been adopted with good results. The supplementary kite A (fig. 2) is attached to the line B C by 30 feet of strong cord tied to a clamp at D. A second clamp is placed at E, so that D E = 30 feet, and A and E are kept apart by a light bamboo some 10 feet long. D A and D E are not necessarily 30 feet, but must be of nearly equal length, and 30 feet is the length that has been used. Of course the bamboo is an objection in that it offers some resistance to the wind, but the resistance is not great. There always used to be anxiety with a second kite lest the wind should temporarily fail and allow the kite to drop on to or under the main wire and foul it, but with the present arrangement this cannot occur, since the bamboo in such a case pushes the wire out of the way.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting was held on Wednesday evening, February 21st, at the Society's Rooms, 70, Victoria Street, Westminster, Mr. Richard Bentley, President, in the chair.

Mr. E. Mawley read his "Report on the Phenological Observations for 1905." He said that as affecting vegetation the weather of the phenological year ending November, 1905, was chiefly remarkable for the dryness and mildness of the winter months, the drought and frosts in May, the long spell of hot and dry weather in July, and an exceptionally cold period in October. Wild plants came into flower a few days earlier than usual until about the beginning of May, after which time they were as a rule late to about the same extent. Most of the early spring migrants, such as the swallow and nightingale, reached these shores in advance of their average dates. The best farm crops of the year were those of wheat, beans and hops, while barley, potatoes, turnips and mangolds were all more or less over average. On the other hand, the yield of oats, peas and hay was almost everywhere deficient—the last being the worst crop of the year. Apples, pears and plums were below average in all parts of the British Isles, whereas the small fruits as a rule yielded well. Taking the farm crops alone, the past year must be regarded as having been on the whole a fairly bountiful one.

Mr. F. C. Bayard referred to the destruction of bud and blossom by wild birds.

Mr. J. E. Clark stated that he had noticed that, besides the apple crop being poor, the fruit was keeping badly. This was especially marked in Somerset, the county of the apple. He also said that, in

spite of the severe frost of last October, at Christmas time there were found in the Croydon district thirty-three species of wild plants in bloom as compared with only seven in the previous year, and of garden varieties fifteen were seen as against seven at Christmas, 1904.

Mr. C. Harding said that Mr. Mawley had now worked up the phenological observations for so long a period that he hoped he would soon forecast the seasons and say whether we were likely to have good or bad crops.

Mr. H. Southall, Mr. J. Hopkinson, Mr. F. Druce, Mr. D. W. Horner, and Mr. N. ffarington, also took part in the discussion.

Mr. Mawley, in reply, said that no doubt the reason why the apples were keeping so badly was that the dull and cold autumn had prevented the fruit from ripening sufficiently.

The President endorsed what had been said about the destruction of buds and blossoms by small birds, as in his neighbourhood in Buckinghamshire they had wrought considerable damage, especially the bullfinches and sparrows. He thought it would be of immense value if accurate forecasts of frosts in the spring months could be established in this country. He had note of one such forecast in California, which, by the farmers taking the necessary precautions, had been the means of saving thousands of dollars.

The other papers read were :—" Brief Discussion of the General Features of the Pressure and Wind Conditions over the Trades-Monsoon Area," by Mr. W. L. Dallas ; and " The Dispersal or Prevention of Fog," by Dr. W. B. Newton.

The following gentlemen were elected Fellows of the Society :— Mr. C. A. Cheyne, Mr. O. Fulton, Lieut.-Col. G. M. J. Giles, Mr. A. J. V. Rapkin, Mr. W. H. Taylor, and Mr. J. W. White.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

HYDROTHERMODYNAMIC THEORY.

I AM grateful for the short analysis of the *Théorie hydrothermodynamique des tourbillons atmosphériques*, which appeared in the last number of the Magazine, but permit me to correct a statement that may lead to a misunderstanding of the constitution of atmospheric whirls according to this theory.

All of us know well the distinct and separate existence of the cyclone and the anticyclone. The analysis referred to attributes to me the assumption that " the cyclone and the anticyclone are parts of one whole, one being always superimposed upon the other and separated by a stratum of air at an elevation of from 18,000 to 21,000 feet." This is too concise to be intelligible.

There are two distinct whirls at the surface of the Earth—one converging, the cyclone, the other diverging, the anticyclone. But both are double in height, and the two superimposed whirls are always symmetrically disposed by their vertical constitutive currents; thus, the superior cyclone is descending as an inferior anticyclone, and the superior anticyclone is ascending as an inferior cyclone.

The existence of these two superimposed and symmetrical whirls is a natural, physical and logical consequence of the fact that the primary cause of the trouble in the air and of the low pressure in the cyclone and of the high pressure in the anticyclone, is to be searched for in the middle region, not at the surface of the Earth. For if that trouble engenders in the subjacent and depressed masses a gyratory motion with ascending current, it necessarily engenders in the superjacent ones a similar gyration with descending current. On the other side, if the masses of air abstracted out of the cyclone in that middle region accumulate finally, as they do, in another part of the same stratum, the resulting overpressure makes the subjacent masses to descend and the superjacent to ascend.

Now the descending whirl upon the cyclone is not a true anticyclone, and the ascending one upon the anticyclone is not a true cyclone, because the first is a column of low pressure continuing the inferior cyclone, and the second a column of high pressure continuing the inferior anticyclone.

This last assumption is the more important as one seems to have groundlessly contradicted or not exactly studied it. I think I have put it in full light in the *Théorie hydrodynamique*, and recently in the Bulletin of the Jersey Observatory for 1905, in a note *Sur la Pression et la Temperature dans les Cyclones et dans les Anticylones: réponse à M. J. Hann.*

MARC DECHEVRENS, S.J.

Observatoire St. Louis, Jersey, 18th February, 1906.

LOCALIZATION OF SNOW ON THE SURREY HILLS, ON FEBRUARY 24th, 1906.

THE distribution of snow-covered ground was very peculiar in the neighbourhood of Dorking on February 24th, showing a relationship, real or apparent, with the geological character of the district.

The chalk of Box Hill and of the North Downs generally to the north of the town was, so far as I could see, completely destitute of snow, the sandy tract of Ranmore Common to the north-west was snow-clad in patches, whilst the sandstone uplands of Leith Hill, together with the adjacent meadows below to the south-west, were covered to a depth varying from two to three inches, and the bare boughs of rugged oaks in meadow and woodland were decked with snow in a beautiful manner. Either the snow-fall which was experienced very generally in the counties south of the Thames in the

early morning of the 23rd had been much heavier towards the south-west of Dorking than towards the north-east, or else a rapid thaw had set in on the chalk hills in the latter direction. Unfortunately, I was quite unprepared to find much snow in Surrey on the date in question, so that within the limits of a few hours I was unable to make such detailed and accurate observations upon the distribution of the covering of snow in relation to the nature of the subjacent rocks as I should otherwise have made; but perhaps readers who may happen to reside in the Dorking district or anywhere along the strip of the upper greensand formation beneath the chalk escarpment, say from Guildford to Sevenoaks, could add to the above remarks concerning the distribution of snow-covered ground on the 23rd and 24th. I do not know whether the subject of the influence which different species of rock in virtue of their different physical constants may exert upon the permanence of a superincumbent layer of snow has yet been submitted to mathematical investigation. In the present connection a comparison, could it have been made, of the temperature before the snow-fall, on and below the surface of the chalk and sandstone of Box Hill and Leith Hill respectively would probably have yielded interesting results, as also would a comparison of the state of the rocks with respect to saturation.

L. C. W. BONACINA.

Hampstead, N. W., Feb. 25th, 1906.

[Was the snow absent from the northern slopes of the North Downs, and was it present on the southern slopes of Leith Hill? In other words, was the distribution not due to exposure to the sun rather than to conduction from the rock?—Ed. *S.M.M.*]

THE GREEN FLASH.

Excuse my observing that Major Courtenay does not say that he saw the green flash before the sun rose above the horizon.

As soon as the whole or a portion of the sun's disc becomes visible at sunrise, the eye will be impressed by the colour of the disc, and exhibit its vital elasticity by producing out of itself the demanded colour, which, if the sun is red, will be green.

Even while the sun is still below the horizon, it is announced by a red light, which colours the atmosphere and tinges the clouds in the neighbourhood. This red light is sufficient to stimulate the retina to produce the opposite colour.

R. C. CANN-LIPPINCOTT.

Over Court, Almondsbury, Bristol, 20th Feb., 1906.

[We hope next month to publish the conclusion of Dr. Rambaut's article on the Green Flash, and subsequently to summarize the interesting correspondence which Admiral Maclear's recent letter has called forth.—Ed. *S.M.M.*]

HIGH TEMPERATURES IN MARCH.

PERHAPS the following abnormally high maximum readings for the season may be of interest. Equally high temperatures were last recorded here in the first week of September. On 6th and 7th inst. there was also heavy dew by 9.0 p.m.

The instruments are Kew verified.

	Max. in Screen.	Solar Radiation (b. b. in v.)
March 6	64°·0	..... 105°·3
,, ,7	65°·6	..... 107°·5

W. J. CARTER.

Montem Road, New Malden, Surrey, 9th March, 1906.

SYDNEY CLIMATOLOGICAL NORMALS.

WE have been favoured with a copy of the summarized climatological observations taken at the Government Observatory at Sydney, New South Wales, during the 46 years 1859 to 1904, containing the averages of the usual meteorological elements and the extreme values noted during that period. Of these averages the most important are quoted in the following table:—

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Barometer (cor.	29·929	29·973	30·054	30·103	30·091	30·036	30·115	30·103	30·045	30·001	29·981	29·918	30·029
Aver. Mean Max. Shade Temp.	78°·2	77°·2	75°·4	70°·8	64°·8	60°·4	58°·9	62°·2	66°·3	71°·0	74°·2	77°·1	69°·7
,, Mean Min. Shade Temp.	64·8	64·8	63·1	58·2	52·0	48·2	45·7	47·5	51·4	55·9	59·6	62·8	56·2
,, Temp. of Sea...	71·4	71·8	70·9	68·3	64·2	59·9	57·3	57·5	60·3	63·3	66·7	69·4	65·1
,, Wind Movement...	mi. 8010	mi. 6447	mi. 6473	mi. 5896	mi. 6046	mi. 6893	mi. 6978	mi. 6678	mi. 6844	mi. 7284	mi. 7426	mi. 7629	mi. 6884
,, Rainfall ..	in. 3·57	in. 4·88	in. 5·10	in. 5·65	in. 5·24	in. 5·51	in. 4·77	in. 3·24	in. 2·97	in. 2·98	in. 3·10	in. 2·50	in. 49·51
,, No. of Rainy Days	14	14	15	13	16	13	12	12	12	13	13	13	160
,, Evaporatn.	in. 5·30	in. 4·22	in. 3·60	in. 2·49	in. 1·58	in. 1·26	in. 1·20	in. 1·50	in. 2·50	in. 3·81	in. 4·68	in. 5·28	in. 37·42

Among the more interesting extremes it may be noted that the maximum shade temperature exceeded 100° in each of the five months November to March, reaching the highest point on January 13th, 1896, when 108°·5 was registered. In no month of the year did the maximum fail to reach 70°, the lowest extreme being 74°·7 in June The lowest minima recorded varied from 51°·2 in January to 35°·9 in July, the mid-winter month, showing that frost in the screen has been unknown in Sydney during the last half-century. The thermometer exposed to terrestrial radiation, however, fell below freezing point on some occasion during each month from May

to September inclusive, the absolute minimum being as low as 24°·0 on July 4th, 1893. Unfortunately details as to the number of ground frosts recorded are omitted, although their occurrence, even at rare intervals, must form an important feature in a sub-tropical climate.

Turning to the extremes of relative humidity it is instructive to remark that on no day in the whole period did this exceed 90 per cent. at 9 a.m., and from September to June never reached 80 per cent, a marked contrast to the climate of London, where complete saturation of the atmosphere is of comparatively frequent occurrence. On the other hand, the amount of moisture never fell so low as in the arid districts of the interior of Australia, the minimum at 9 a.m. being above 60 per cent. in eight months of the year, and never less than 55 per cent.

Some of the most remarkable of the figures quoted are undoubtedly the extremes of rainfall. Although the annual total is on the average less than 50 inches and the number of rainy days as many as 160,* eight months of the year, chiefly in autumn and winter, show daily maxima exceeding 5·00 in. February, April and May had each falls of more than 7·00 in. in 24 hours, the greatest being 8·90 in. on February 25th, 1873.

The monthly means fall into a well-marked seasonal curve, reaching a maximum in April, corresponding to the October maximum of the north temperate zone, and a relatively dry season during the second half of the year, or spring and early summer. Every month, except December, is liable to a fall of 10 inches and April and May have exceeded 20 inches. The driest months in each instance had less than ·50 in., but there was no absolutely rainless month.

No information is given as to the instruments employed in arriving at the average amounts of evaporation, but if these can be relied upon, considerably more than two-thirds of the annual rainfall is returned to the atmosphere in this direct manner.

THE CYCLONIC DISTRIBUTION OF RAINFALL,

Mr. J. A. Udden has published a paper† bearing on the methods of studying the distribution of weather conditions in cyclones, a full abstract of which may prove interesting. The work was suggested by a lecture delivered by a "Weather Bureau man," who "especially emphasized a statement we often find in text-books, that the greatest precipitation occurs in the region which lies some distance to the

* It may be noted that the number of rainy days is the same as in London, while the amount of rainfall is twice as great, so that the average fall of rain per day in Sydney is twice as great as in London.

† "On the Cyclonic Distribution of Rainfall." By Johan August Udden. Published by Authority of the Board of Directors of Augustana College and Theological Seminary, Rock Island, Ill. 1905. Size 10¼ × 8. Pp. 22.

south-east of an area of low pressure," and by the remark of an observer of the weather at Davenport, Ill., who observed that the Weather Bureau forecasts usually came true, but that the predicted storms were apt to be a little behind time. Mr. Udden thought that there might be some connection between the two statements and resolved to determine by some statistical method the actual relation of weather conditions to different parts of a cyclone for his locality.

He accordingly made a diagram, reproduced in fig. 1, which represented a circular cyclone 2000 miles in diameter. The inner circle

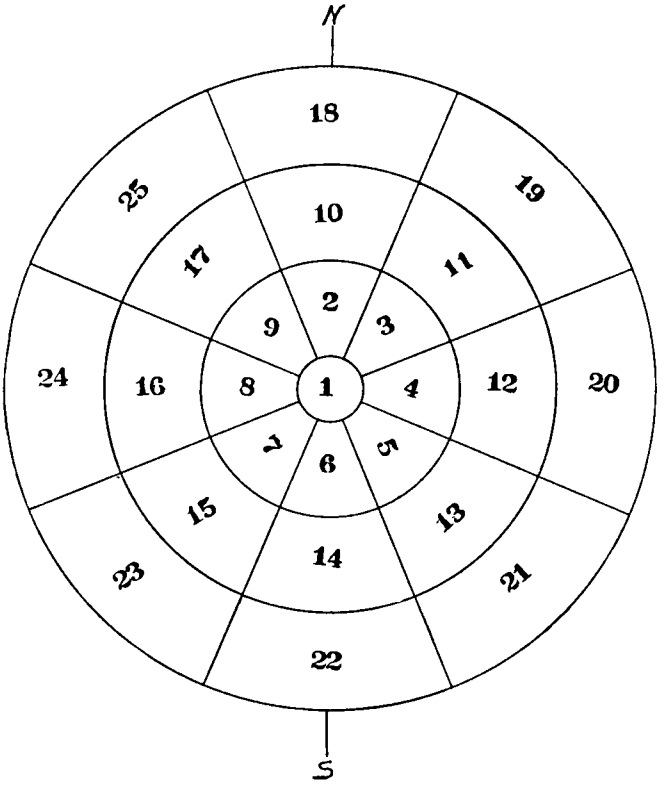

Fig. 1.

has a radius representing 100 miles, and the succeeding circles have radii each 300 miles longer than the one before. The circles are divided by eight radii and the resulting compartments numbered from 1 to 25, as shown. His method was then simply to take a sufficient number of observations of the weather at Davenport when that station lay in any one of the 25 corresponding tracts of an actual cyclone and to average these for each tract separately and thus obtain for each separate percentages expressing frequency of certain

weather conditions—precipitation, cloudiness and resultant wind direction being the three to which special attention was directed.

The observations at Davenport were made at 8 a.m. during about five years, the data being taken from the daily weather maps. About 1000 observations resulted, distributed somewhat unequally throughout the 25 tracts, but enough to secure a fairly representative average. "In other words: the number of times precipitation occurred or cloudiness prevailed was noted when Davenport was located in any one of the designated tracts with reference to the centre of a low area, and also the total number of times the opposite conditions prevailed. From these two figures percentages were obtained showing the comparative frequency of precipitation or cloudiness in each tract."

The result of this study was to show that at Davenport precipitation is most frequent when the station lies in tract No. 8, and relatively least frequent in the tracts to the south-east of the centre. Hence Mr. Udden points out that if precipitation is predicted on the assumption that the maximum frequency lies to the south-east of the centre a considerable number of hours will usually elapse before the wettest part of the cyclone, lying west of the centre, passes over

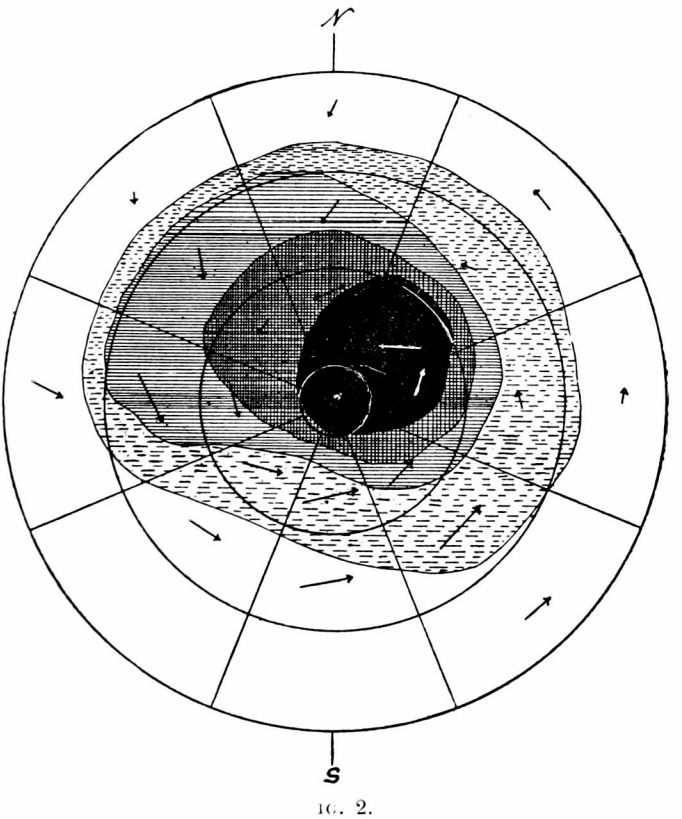

FIG. 2.

the place and thus the postponement of the prediction is accounted for.

Enlisting the aid of his students, Mr. Udden proceeded to make similar studies of other localities, representative of four different climatic regions of the United States, but in these he combined results from different stations—viz., Amarillo, Dodge City, Wichita, and Oklahoma, during 1894—98, to represent the south-western plains; Helena, Miles City, Leander and Boise City, for 1899; nine stations in the Upper Missouri Valley, for 1899; and finally Detroit and Buffalo for the years 1900—1903. The result was to "show clearly that the area of the greatest rain and snowfall is not in the same position with regard to the centres of low areas in different climatic regions. In every case it is eccentric and lies to the west, north-west, north or north-east, in the cases studied, but in no instance to the south-east." We reproduce in fig. 2 the diagram of the distribution of precipitation and wind direction in a composite cyclone, based on the 8 a.m. observations at Detroit and Buffalo, where the heaviest precipitation lay in tract 3.

Mr. Udden indicates several lines of future research suggested by his first results, although the purpose of his paper was merely to call attention to the method of averaging. He suggests that diagrams for different hours of the day might show different results, that summer and winter cyclones are unlike, "and it is believed that there are differences among the cyclones coming along different paths."

The above is a full abstract of the paper before us. Several points are left obscure. We are not told what limits of intensity were adopted in the estimation of the frequency of precipitation or cloud, nor is it stated whether only cyclones which preserved the cyclonic form of isobars for 1000 miles from the centre were included, or whether smaller cyclones merging into anticyclonic areas were also taken into account. The last suggestion quoted above as to differences in the direction of the path producing different effects is probably of high importance. The study of the distribution of rain in individual cyclones, by Dr. H. R. Mill,* has shown that in the majority of rain-bringing cyclones which cross the British Isles, by far the greatest amount of precipitation occurs on the left of the track in whatever direction the cyclone is moving; and this suggests that it might be expedient to number the tracts in Mr. Udden's plan, not with relation to the cardinal points, but rather with reference to the diameter which lies in the line of the track of the centre.

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* "On the Unsymmetrical Distribution of Rainfall about the path of a Barometric Depression," *Symons's Meteorological Magazine*, **39** (1904), 161-165, and in *Report* of Eighth International Geographic Congress, 1904. Washington, 1905 Pp. 393—396.

REVIEWS.

Lehrbuch der Meteorologie von DR. JULIUS HANN. *Zweite, neubearbeitete Auflage.* Leipzig: 1906, C. H. Tauchnitz. Size $10\frac{1}{2} \times 7\frac{1}{2}$, Pp. xii. + 644. Plates. Price 24 Marks.

PROFESSOR HANN'S hunger for hard work has urged him to prepare a new and completely revised edition of his great text book of Meteorology, in which he brings the volume to date and improves it in every part. Much has been done by meteorologists in the five years which separate the second edition from the first, and the greatest tribute to the author's genius which any critic can offer is to point out that while nothing of real importance has been omitted, the new edition is 160 pages shorter than the old. This is brought about by a reduction of the very voluminous references to the older literature of the subject given in the first edition, and by a general compression of the subject matter, which was not possible when the book was being assembled out of the scattered constituent parts. We may look on the new *Lehrbuch* as the completed scheme towards which the author was working, freed from the scaffolding naturally required in putting the facts together for the first time.

Special attention is given to the results obtained by the investigations of the upper atmosphere, which form so important a feature of recent meteorological work. Amongst the additions and improvements we may also note a table of the mean monthly and annual temperatures at 143 places in all parts of the Earth, a shorter table of mean monthly and yearly rainfall at selected places, together with hygrometric and barometric tables. We have noticed several trifling typographical errors which have escaped mention in the table of errata, but most of these are of a kind which should have been put right by the printer's reader and do not reflect on the keenness of the author or his scrupulous exactitude in matters of scientific fact.

The Meteorology of the Ben Nevis Observatories. Part III., containing the Observations for the years 1893, 1894, 1895, 1896 and 1897, with Appendix. Edited by ALEXANDER BUCHAN, LL.D., F.R.S., and ROBERT TRAILL OMOND. *Forming Volume XLIII. of the Transactions of the Royal Society of Edinburgh.* Edinburgh: 1905. Size $12 \times 9\frac{1}{2}$. Pp. 566.

THIS substantial volume contains the hourly readings of the meteorological instruments at the summit and low-level Ben Nevis Observatories for the five years 1893—97. In addition to the Tables, which occupy some 500 pages, there are two memoirs: the first, by Dr. Buchan, on the interrelation of barometric pressure, temperature, humidity, rainfall, cloud, sunshine, and wind, illustrated by the observations made at the two Observatories; and the second, by Dr. A. J. Herbertson, a report on hygrometric researches mainly at the Ben Nevis Observatories.

TEMPERATURE FOR FEBRUARY, 1906.

STATION.	COUNTY.	Lat. N.	Long. W. [°E.]	Height above Sea.	TEMPERATURE. Max.		TEMPERATURE. Min.		No. of Nights at or below 32	
									Shade.	Grass.
		° ′	° ′	ft.	°	Date.	°	Date.		
Camden Square	*London*	51 32	0 8	111	51·1	24	26·1	22	14	21
Tenterden	*Kent*	51 4	*0 41	190	50·5	16	27·0	22	11	17
Hartley Wintney	*Hampshire*	51 18	0 53	222	49·0	25	23·0	6, 22	17	21
Hitchin	*Hertfordshire*	51 57	0 17	238	47·0	10	25·0	5	19	...
Winslow (Addington)	*Buckinghamshr.*	51 58	0 53	309	49·0	25	19·0	6	17	25
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	51·0	25	26·0	9	...	...
Brundall	*Norfolk*	52 37	*1 26	66	.	...	...	...	...	...
Alderbury	*Wiltshire*	51 2	1 44	263	50·0	1, 21	20·0	5	18	...
Winterbourne Steepleton	*Dorset*	50 42	2 31	316	48·8	26	20·0	6	13	18
Torquay (Cary Green)	*Devon*	50 28	3 32	12	51·5	20	29·6	6	3	22
Polapit Tamar [Launceston]	,,	50 40	4 22	315	49·4	16	25·6	6	9	13
Bath	*Somerset*	51 23	2 21	67	50·5	10	22·0	6	14	...
Stroud (Upfield)	*Gloucestershire*	51 44	2 13	226	48·0	1, 26	25·0	5	15	...
Church Stretton (Woolstaston)	*Shropshire*	52 35	2 48	800	48·0	23	24·0	9 ‡	25	...
Bromsgrove (Stoke Reformatory)	*Worcestershire*	52 19	2 4	225	45·0	25	21·0	5	21	...
Boston	*Lincolnshire*	52 58	0 1	25	45·0	10	25·0	6	17	...
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	51·6	26	24·5	6	19	26
Derby (Midland Railway)	*Derbyshire*	52 55	1 28	156	49·0	26	22·0	6	18	...
Bolton (Queen's Park)	*Lancashire*	53 35	2 28	390	47·6	7	27·1	5	14	26
Wetherby (Ribston Hall)	*Yorkshire, W.R.*	53 59	1 24	130	...	...	...	...	...	...
Arncliffe Vicarage	,, ,,	54 8	2 6	732	...	...	...	...	...	...
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	48·0	1	26·0	18	18	26
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	...	...	...	...	...	...
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	45·1	9	24·0	5	15	...
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	...	...	...	...	...	...
Haverfordwest (High Street)	*Pembroke*	51 48	4 58	95	49·0	8	26·4	18	11	20
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	50·0	8 †	21·0	4	15	...
Llandudno	*Carnarvon*	53 20	3 50	72	49·2	25	31·0	18	2	...
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	47·0	1, 6, 7	22·0	25	17	...
Lilliesleaf (Riddell House)	*Roxburgh*	55 31	2 46	550	47·0	19	22·0	4, 12	23	27
Edinburgh (Royal Observy.)	*Midlothian*	55 55	3 11	442	48·3	1	25·3	9	17	22
Colmonell (Clachanton)	*Ayr*	55 8	4 54	140	47·0	21, 22	21·0	4	12	...
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	46·0	1	20·0	11	20	27
Tighnabruaich	*Argyll*	55 55	5 14	50	42·0	1	24·0	23	24	26
Mull (Quinish)	,,	56 36	6 13	35	45·0	1	...	...	...	...
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	47·3	6	23·4	5	20	...
Braemar	*Aberdeen*	57 0	3 24	1114	...	...	...	...	...	...
Aberdeen (Cranford)	,,	57 8	2 7	120	48·0	1	20·0	9	26	...
Cawdor (Budgate)	*Nairn*	57 31	3 57	250	...	...	...	...	...	...
Invergarry	*E. Inverness*	57 4	4 47	130?	...	...	...	...	...	...
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	...	...	...	...	...	...
Dunrobin Castle	*Sutherland*	57 59	3 56	14	47·0	18	24·0	9	22	...
Castletown	*Caithness*	58 35	3 23	100	46·0	21	17·0	10	21	25
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	52·5	21	30·0	18	...	...
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	50·0	2, 26	24·0	5, 14	15	...
Broadford (Hurdlestown)	*Clare*	52 48	8 38	167	44·0	var.	23·0	10, 11	13	...
Carlow (Browne's Hill)	*Carlow*	52 50	6 53	291	...	...	...	...	...	...
Dublin (Fitz William Square)	*Dublin*	53 21	6 14	54	50·1	1	29·1	12	9	20
Ballinasloe	*Galway*	53 20	8 15	160	53·2	18, 24	21·0	21	20	...
Clifden (Kylemore House)	,,	53 32	9 52	105	...	...	...	...	...	...
Crossmolina (Enniscoe)	*Mayo*	54 4	9 18	74	...	...	...	...	...	..
Seaforde	*Down*	54 19	5 50	180	47·0	1, 9	27·0	var.	19	23
Londonderry (Creggan Res.)	*Londonderry*	54 59	7 19	320	...	...	...	...	...	...
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	46·0	1, 7, 28	27·0	13, 20	17	24

† and 16, 25. ‡ and 10, 11, 12

RAINFALL FOR FEBRUARY, 1906.

RAINFALL OF MONTH.							RAINFALL FROM JAN. 1.					
Aver. 70-99.	1906.	Diff. from Av.	% of Av.	Max. in 24 hours.		No. of Days	Aver. 1870-99.	1906.	Diff. from Aver.	% of Av.	Mean Annual 1870-1899.	STATION.
in.	in.	in.		in.	Date.		in.	in.	in.		in.	
1·62	1·89	+ ·27	117	·37	17	21	3·51	5·91	+2·40	168	25·16	Camden Square
1·85	2·22	+ ·37	120	·38	17	17	4·21	5·86	+1·65	139	28·36	Tenterden
2·06	1·95	— ·11	95	·43	17	20	4·45	6·29	+1·84	141	27·10	HartleyWintney
1·54	1·63	+ ·09	106	·31	16	18	3·35	5·17	+1·82	154	24·66	Hitchin
1·73	1·85	+ ·12	107	·25	16	19	3·78	5·52	+1·74	146	26·75	Addington
1·55	2·39	+ ·84	154	·43	19	21	3·25	6·03	+2·78	185	25·39	Westley
1·49	2·58	+1·09	173	·45	16	21	3·16	6·52	+3·36	206	25·40	Brundall
2·21	2·78	+ ·57	126	·40	16, 22	17	4·88	8·43	+3·55	173	29·17	Alderbury
3·11	4·18	+1·07	134	·75	22	22	7·01	13·09	+6·08	187	39·00	Winterbourne Stpltn
2·87	3·81	+ ·94	133	·90	22	19	6·06	10·02	+3·96	165	35·00	Torquay
2·84	5·34	+2·50	188	·78	16	25	6·71	12·80	+6·09	191	38·85	Polapit Tamar
2·12	2·09	— ·03	99	·57	22	20	4·64	6·35	+1·71	137	30·75	Bath
2·13	1·81	— ·32	85	·24	16	18	4·59	6·52	+1·93	142	29·85	Stroud
2·27	2·65	+ ·38	117	·35	8	18	5·08	6·81	+1·73	134	33·04	Woolstaston
1·63	1·51	— ·12	93	·30	8	12	3·54	5·05	+1·51	143	24·50	Bromsgrove
1·55	2·46	+ ·91	159	·45	27	14	3·14	4·90	+1·76	156	23·30	Boston
1·58	1·96	+ ·38	124	1·00	27	19	3·32	4·87	+1·55	147	24·70	Hodsock Priory
1·66	2·57	+ ·91	155	·82	27	20	3·61	5·85	+2·24	162	26·18	Derby
2·67	4·52	+1·85	169	·63	10	22	6·05	10·99	+4·94	182	42·43	Bolton
1·63	2·05	+ ·42	126	·45	27	20	3·52	6·00	+2·48	171	26·96	Ribston Hall
4·74	5·69	+ ·95	120	·79	10	18	11·07	15·65	+4·58	141	60·96	Arncliffe Vic.
1·86	1·71	— ·15	92	·52	27	16	3·66	4·21	+ ·55	115	27·02	Hull
1·58	1·05	— ·53	66	·38	19	16	3·54	3·47	— ·07	98	27·99	Newcastle
1·64	9·34	—2·30	80	1·61	9	16	26·35	29·27	+2·92	111	132·68	Seathwaite
3·13	4·12	+ ·99	132	·66	16	24	6·98	11·69	+4·71	167	42·81	Cardiff
3·70	4·06	+ ·36	110	·71	22	22	8·83	11·40	+2·57	129	47·88	Haverfordwest
3·03	4·14	+1·11	137	·50	9	22	6·90	11·39	+4·49	165	45·41	Gogerddan
1·97	2·94	+ ·97	149	·47	9	18	4·54	6·82	+2·28	150	30·98	Llandudno
3·62	2·53	—1·09	70	·50	15	11	8·16	7·37	— ·79	90	43·43	Cargen
2·41	1·44	— ·97	60	·30	25	14	5·01	4·42	— ·59	88	33·04	Riddell House
...	1·01	...	...	·26	19	12	...	4·12	...	...	....	Edinburgh
3·67	2·83	— ·84	77	·44	24	17	8·19	7·73	— ·46	94	44·85	Colmonell
2·53	2·84	+ ·31	112	·48	24	18	5·78	7·61	+1·83	132	35·80	Glasgow
4·57	6·19	+1·62	135	·69	16	19	10·43	13·39	+2·96	128	57·90	Tighnabruaich
4·50	4·65	+ ·15	103	·85	24	21	10·35	11·46	+1·11	111	57·53	Quinish
2·10	·70	—1·40	33	·25	24	13	4·20	2·75	—1·45	66	28·95	Dundee
2·70	2·87	+ ·17	106	...	...	...	5·61	6·50	+ ·89	116	36·07	Braemar
2·43	2·52	+ ·09	104	·55	24	20	4·75	4·09	— ·66	86	33·01	Aberdeen
1·86	2·18	+ ·32	117	·45	8	16	4·00	4·94	+ ·94	124	29·37	Cawdor
4·89	2·22	—2·67	46	·41	25	8	11·52	14·95	+3·43	130	56·00	Invergarry
5·77	6·50	— ·27	96	·88	25	25	15·52	21·20	+5·68	137	86·50	Bendamph
2·39	5·81	+3·42	243	1·62	25	16	5·01	8·68	+3·67	173	31·60	Dunrobin Castle
...	6·49	...	...	1·84	10	25	...	9·24	...	...	...	Castletown
5·44	4·64	— ·80	85	·61	12	27	12·01	11.00	—1·01	92	58·11	Killarney
3·30	3·69	+ ·39	112	1·48	22	17	7·36	8·55	+1·19	116	39·30	Waterford
2·19	2·87	+ ·68	131	·38	12	25	5·17	8·23	+3·06	159	33·47	Hurdlestown
2·61	2·62	+ ·01	100	·61	18	19	5·76	6·48	+ ·72	113	34·44	Carlow
1·98	1·64	— ·34	83	·38	22	20	4·14	5·77	+1·63	139	27·75	Dublin
2·48	3·04	+ ·56	123	·63	9	24	5·97	8·74	+2·77	146	37·04	Ballinasloe
6·08	6·05	— ·03	100	·75	9, 24	23	13·94	17·13	+3·19	123	80·23	Kylemore House
4·01	4·84	+ ·83	121	·52	15	25	9·01	11·92	+2·91	132	50·50	Enniscoe
2·97	2·05	— ·92	69	·39	19	19	6·60	6·02	— ·58	91	38·61	Seaforde
2·73	3·94	+1·21	144	·48	2	27	6·29	9·71	+3·42	154	41·20	Londonderry
2·49	3·00	+ ·51	120	·40	2	20	5·83	8·34	+2·51	143	37·85	Omagh

SUPPLEMENTARY RAINFALL, FEBRUARY, 1906.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Abinger Hall	2·39	XI.	Rhayader, Tyrmynydd	7·00
,,	Ramsgate, West Cliff Villas	1·57	,,	Lake Vyrnwy	6·51
,,	Hailsham	3·06	,,	Llangyhanfal, Plâs Draw	2·53
,,	Crowborough, Uckfield Lodge	3·26	,,	Criccieth, Talarvor	4·10
,,	Osborne, Newbarn Cottage.	3·66	,,	Llanberis, Pen-y-pass	14·28
,,	Emsworth, Redlands	3·10	,,	Lligwy	3·36
,,	Alton, Ashdell	3·11	,,	Douglas, Woodville	3·75
,,	Newbury, Welford Park	2·55	XII.	Stoneykirk, Ardwell House	1·56
III.	Harrow Weald, Hill House.	2·10	,,	Dalry, The Old Garroch	4·97
,,	Oxford, Magdalen College..	1·35	,,	Langholm, Drove Road	3·84
,,	Bloxham Grove	1·81	,,	Moniaive, Maxwelton House	3·47
,,	Pitsford, Sedgebrook	2·22	XIII.	N. Esk Reservoir [Penicuick]	2·35
,,	Huntingdon, Brampton	1·71	XIV.	Maybole, Knockdon Farm..	2·56
,,	Wisbech, Bank House	1·98	,,	Campbeltown, Witchburn	3·94
IV.	Southend Water Works	1·42	XV.	Inveraray, Newtown	5·70
,,	Colchester, Lexden	1·93	,,	Ballachulish House	6·52
,,	Newport, The Vicarage	2·10	,,	Islay, Eallabus	5·65
,,	Rendlesham	1·96	XVI.	Dollar Academy	2·76
,,	Swaffham	2·35	,,	Loch Leven Sluice	2·11
,,	Blakeney	1·91	,,	Balquhidder, Stronvar	4·03
V.	Bishops Cannings	2·75	,,	Perth, Pitcullen House	1·44
,,	Ashburton, Druid House	5·38	,,	Coupar Angus Station	1·24
,,	Okehampton, Oaklands	5·43	,,	Blair Atholl	3·31
,,	Hartland Abbey	4·71	,,	Montrose, Sunnyside Asylum	1·12
,,	Lynmouth, Rock House	4·48	XVII.	Alford, Lynturk Manse	2·31
,,	Probus, Lamellyn	5·44	,,	Keith Station	2·41
,,	Wellington, The Avenue	2·82	XVIII.	N. Uist, Lochmaddy	3·56
,,	North Cadbury Rectory	2·70	,,	Alvey Manse	1·92
VI.	Clifton, Pembroke Road	2·53	,,	Loch Ness, Drumnadrochit.	3·42
,,	Moreton-in-Marsh, Longboro'	2·25	,,	Glencarron Lodge	6·36
,,	Ross, The Graig	1·23	,,	Fearn, Lower Pitkerrie	2·57
,,	Shifnal, Hatton Grange	1·46	XIX.	Invershin	4·09
,,	Cheadle, The Heath House.	3·10	,,	Altnaharra	6·42
,,	Coventry, Kingswood	2·64	,,	Bettyhill	5·39
VII.	Market Overton	1·80	,,	Watten Station	4·17
,,	Market Rasen	2·25	XX.	Dunmanway, The Rectory..	5·28
,,	Bawtry, Hesley Hall	2·01	,,	Cork	2·85
VIII.	Neston, Hinderton	1·98	,,	Darrynane Abbey	4·75
,,	Southport, Hesketh Park	3·26	,,	Glenam [Clonmel]	3·41
,,	Chatburn, Middlewood	3·22	,,	Ballingarry, Gurteen	2·54
,,	Cartmel, Flookburgh	2·78	,,	Miltown Malbay	4·21
IX.	Langsett Moor, Up. Midhope	4·27	XXI.	Gorey, Courtown House	2·58
,,	Scarborough, Scalby	2·04	,,	Moynalty, Westland	2·81
,,	Ingleby Greenhow	2·18	,,	Athlone, Twyford	2·84
,,	Mickleton	1·34	,,	Mullingar, Belvedere	2·91
X.	Bardon Mill, Beltingham	1·30	XXII.	Woodlawn	3·85
,,	Ewesley, Fallowlees	1·19	,,	Westport, Murrisk Abbey..	4·49
,,	Ilderton, Lilburn Cottage..	·95	,,	Collooney, Markree Obsy..	4·20
,,	Keswick, York Bank	4·10	XXIII.	Enniskillen, Portora	3·13
XI.	Llanfrechfa Grange	3·90	,,	Warrenpoint, Summer Hill.	2·21
,,	Treherbert, Tyn-y-waun	7·29	,,	Banbridge, Milltown	2·42
,,	Carmarthen, The Friary	4·56	,,	Belfast, Springfield	3·29
,,	Castle Malgwyn [Llechryd].	4·20	,,	Bushmills, Dundarave	2·62
,,	Plynlimon	10·08	,,	Stewartstown, The Square..	2·78
,,	Tall-y-llyn	3·10	,,	Killybegs	6·21
,,	New Radnor, Ednol	3·86	,,	Horn Head	4·31

METEOROLOGICAL NOTES ON FEBRUARY, 1906.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

LONDON, CAMDEN SQUARE.—Rainy and unpleasant conditions continued with little intermission until about 19th, but with considerably reduced temp.; the last week was, however, somewhat more genial. Mean temp. 38°·7, or 1°·1 below the average and 3°·2 below the mean for January, 1906. Duration of sunshine 67·9* hours and of R 52·2 hours.

CROWBOROUGH.—R was ·92 in. above the average, making the excess for the year equal to the average for March and April together. Mean temp. 37°·3, or 0°·5 below the average.

HARTLEY WINTNEY.—After the first week, which was dry, frost at night alternated with R during the day and strong N.W. and W. winds. Short, sharp TS with S, H and R on 8th. Mean amount of ozone 4·1.

TORQUAY.—Mean temp. 41°·8, or 1°·4 below the average. Duration of sunshine 121·4* hours, or 39·9 hours above the average. Mean amount of ozone 5·4. The sunniest February since 1891.

WELLINGTON.—Stormy and colder than January with many small falls of S, but R only slightly above the normal.

NORTH CADBURY.—A cold, raw month and the windiest February in 10 years. Great duration of R, but a fall only slightly above the average,

WORKSOP.—Unsettled but sunny, with many frosts, low pressure, and mean temp. 1°·5 below the average. Duration of sunshine the greatest in 25 years except in 1887.

BOLTON.—Cold, wet and changeable, with mean temp. 36°·5, or 1°·1 below the average. Duration of sunshine 49·7* hours, or 10·3 hours above the average. A blizzard, with strong W.S.W. wind, T and L, occurred on 8th, the mean depth of S being about 5 inches.

SOUTHPORT.—Exceptionally sunny, yet wet and stormy. Mean temp. 38°·2, or 0°·8 below the average, the extreme range being the smallest on record in February. Duration of sunshine 98·4 * hours, or 29·8 hours above the average, and of R 72·6 hours.

CARMARTHEN.—Unusually wet, with cold winds, sleet and cold R. Agricultural labour was retarded by the wet weather.

HAVERFORDWEST.—Moderate R and unusually low day temp. not once reaching 50°. Duration of sunshine 80·3 * hours. Gales on five days.

DOUGLAS.—Quite a winter month, wet and stormy with temp. below the average throughout, but no great cold and an excess of bright sunshine.

COUPAR ANGUS.—Cold and stormy generally with several S storms. R ·71 in. below the average of 25 years. Mean temp. 35°·1, or 1°·4 below the average.

LYNTURK MANSE.—S lay on the ground throughout, and roads were more blocked than usual, owing probably to the frequent changes of wind.

DRUMNADROCHIT.—The month was one prolonged S storm, but the temp. was fairly high and there were no very keen frosts. R ·49 in., and rainy days 2, above the average of 20 years.

WATTEN.—A series of gales, S and R storms, with some clear frosty days.

DARRYNANE ABBEY.—Constant R but no very heavy fall, the total being only 4·2 per cent. above the average. About two inches of S on 11th.

DUBLIN.—Cold and changeable, with frequent but not heavy R, which often fell as H or sleet. Mean temp. 39°·7; low night temp., and max. reaching 50° on one day only.

BELFAST.—R above the average and of infinite service to the soil. S and frost were more prominent than usual.

OMAGH.—A raw, damp, and generally rainy month, but with no greater indication of winter than a few light night frosts and an occasional forenoon with the ground almost white with S.

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* Campbell-Stokes.

Climatological Table for the British Empire, September, 1905.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	76·5	3	42·7	15	65·9	50·1	51·0	83	118·7	36·6	2·09	12	6·0
Malta	92·1	26	65·3	22	85·6	71·5	68·6	75	141·8	61·7	·94	2	1·9
Lagos	86·0	9	71·0	2	83·0	74·0	72·0	78	144·0	62·5	1·54	13	7·2
Cape Town	80·7	17	44·0	16	65·0	52·1	50·4	75	...	...	1·59	7	5·8
Durban, Natal	84·6	29	50·6	18	76·3	59·2	...	...	138·4	...	2·39	16	4·8
Johannesburg	81·8	23	29·0	17	70·9	47·9	42·0	60	144·9	23·3	·22	4	2·6
Mauritius	81·2	21	53·2	2	79·1	62·4	62·2	76	145·8	42·7	2·00	12	5·9
Calcutta	93·0	19	74·6	29	88·3	78·2	77·5	85	166·2	73·1	11·20	18	7·7
Bombay	88·3	29	75·5	9	85·8	77·3	74·9	81	135·3	71·8	6·16	14	5·9
Madras	101·8	26	74·8	2	95·3	79·1	74·2	74	152·1	73·2	2·77	8	5·7
Kodaikanal	69·0	30	50·4	28	63·8	52·4	51·0	81	140·6	32·8	7·34	23	6·9
Colombo, Ceylon	88·4	3	73·2	6	86·1	76·2	74·3	82	149·2	70·0	10·75	20	5·8
Hongkong	89·6	2	71·3	19	84·7	76·5	73·7	81	142·9	...	3·20	15	6·5
Melbourne	70·0	13	32·0	18	56·4	42·0	39·5	74	129·5	25·0	2·46	16	6·8
Adelaide	75·1	12	35·9	28	52·0	43·5	40·7	72	133·6	31·5	1·51	17	5·9
Coolgardie	74·2	15	36·0	5	65·6	42·9	40·0	57	149·0	30·4	·70	6	3·7
Sydney	75·3	4	41·0	7	64·4	47·3	40·3	62	122·3	30·1	2·50	12	3·5
Wellington	59·5	1	38·5	30	55·5	45·7	43·3	77	116·0	33·0	6·02	18	7·0
Auckland	63·0	5	43·0	6	59·8	48·3	48·2	80	126·0	37·0	4·48	25	6·0
Jamaica, Negril Point	89·1	5	70·7	20	87·2	73·5	74·3	80	...	...	4·22	11	...
Trinidad	90·0	sev.	68·0	12	87·2	71·1	73·1	84	170·0	64·0	10·43	17	...
Grenada	88·6	17	72·0	7	84·8	75·0	72·5	76	150·0	...	5·42	20	3·3
Toronto	83·2	30	31·9	26	71·5	53·1	55·6	79	...	26·0	1·73	12	4·9
Fredericton	78·7	10*a*	29·5	15	65·8	45·5	46·7	64	...	...	3·25	13	6·1
Winnipeg	86·0	29	29·0	12	70·8	46·3	...	...	...	...	1·56	9	4·3
Victoria, B.C.	75·0	1	44·4	29	61·5	51·2	...	...	...	...	4·03	15	7·4
Dawson	58·4	1	18·8	20	45·7	33·3	...	...	...	...	3·52	15	6·8

a and 11.

MALTA.—Mean temp. of air 77°·4, or 2°·4 above, mean hourly velocity of wind 7·1 miles, or 0·7 below, average. Mean temp. of sea 79°·7.

Mauritius.—Mean temp. of air 0°·5, dew point 2°·0, and R ·61 in. above averages. Mean hourly velocity of wind 7·6 miles, or 4·4 below average. Mean computed direction E.

MADRAS.—Bright sunshine 150·7 hours.

KODAIKANAL.—Bright sunshine 122 hours.

HONGKONG.—Mean temp. of air 80°·1. Mean direction of wind E., and mean hourly velocity 14·8 miles. Bright sunshine 199·5 hours.

Adelaide.—Mean temp. of air 5°·1 below average. The coldest September in 48 years' record. R ·21 in. below average.

Sydney.—Temp. of air 2°·9 below, humidity 7·6 below, and R ·46 in. below, averages.

Wellington.—Mean temp. of air 1°·0 below, and R 1·50 in. above, averages.

Auckland.—Mean temp. of air slightly below average, and R 1·00 in. above the previous 37 years' average.